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Engineering Consultation, Investigation, and
Analysis

June 2, 2022

Kevin Forsberg, J.D.
Forsberg Law Firm, PC
15899 Highway 105 West
Montgomery, Texas 77356

Dear Mr. Forsberg,

At your request, I am providing you with this report detailing my initial opinions in the matter of Lori Duff v ABM Aviation, Incorporated (hereafter, referred to as ABM). I base my opinions on my education and professional experience, my review of the case documents provided to me to date, and my review of scientific and technical literature pertaining to wheelchair mobility, wheelchair-related accidents with injuries, and aisle wheelchairs.

Education and Professional Experience

From June 1983 to March 2021, I was employed by the Commonwealth of Virginia to provide rehabilitation engineering services and assistive devices to individuals with disabilities. For 35 years, I specialized in the area of seating and wheeled mobility. In that capacity, I worked with healthcare professionals to provide wheelchairs and seating systems for individuals with disabilities who had mobility impairments. This included individuals who were dependent upon others to mobilize their manual wheelchair. A significant aspect of my clinical practice focused on wheelchair safety.

I served as a clinical staff member on two federally-funded research grants that focused on research and development in seating and wheeled mobility, as well as improving care for individuals with spinal cord injury. The former, a Rehabilitation Engineering Research Center grant, developed state-of-the-art wheelchairs, wheelchair components, and seating technologies for use by individuals with disabilities. The latter, a model Spinal Cord Injury System grant, focused in part on the assistive technology needs of individuals with spinal cord injury.

I have been an educator in rehabilitation engineering and assistive technology throughout my career. I have assisted in developing and delivering federally-funded and state-funded graduate-level and post-graduate training. I was a co-author and faculty member of the University of Virginia's Rehabilitation Engineering Training Program and, later, was the Co-Director of the University's Rehabilitation Technology Training Program. In addition, I developed and provided seating and wheeled mobility continuing education courses that were delivered throughout the Mid-Atlantic States. I worked with RESNA, The Rehabilitation Engineering and Assistive Technology Society of North America, to develop the guidance document, Guidelines for Advanced Curriculum Development for Seating and Mobility Assistive Technology Practitioners. I assisted the University of Pittsburgh in the development

of their Assistive Technology Training Program for Rehabilitation Technology Suppliers. Lastly, as an Assistant Professor of Medical Education in Physical Medicine and Rehabilitation, I assisted in the education of students, medical residents, and clinicians at the University of Virginia, focusing on assistive technologies and their usage.











I have published peer-reviewed articles in the realm of seating and wheeled mobility and have served as a reviewer of scientific paper submissions for RESNA's annual conference. The scientific papers that I reviewed were submitted for consideration by RESNA's Special Interest Group, Wheeled Mobility and Seating.




















I am registered by the Commonwealth of Virginia as a Professional Engineer, a registration I have held since 2000. My registration is in mechanical engineering. I also earned a Master of Engineering degree in Biomedical Engineering from the University of Virginia in 1984, with a concentration in Rehabilitation Engineering.

A copy of my CV is found here: [Link to CV.](#)

Review of Case Documents

I have reviewed the following documents provided to me:

Name	Date modified	Type	Size
 Duff - ABM Aviation Inc's Production Documents - ABM000039 - 000117 (2).pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	23,866 KB
 Duff - Plaintiff's Production Docs to Defendant, Frontier Airlines, Inc - 4-8-21.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	174,262 KB
 frontier pro. docs.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	2,348 KB
 frontier pro. docs0001.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	2,322 KB
 frontier pro. docs0002.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	580 KB
 plains pro docs.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	3,412 KB
 duff pro docs0004.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	5,127 KB
 duff pro docs0005.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	1,716 KB
 duff pro docs0006.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	585 KB
 duff.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	14,574 KB
 duff pro docs0002.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	10,215 KB
 duff pro docs0003.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	17,020 KB
 duff pro docs.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	6,826 KB
 duff pro docs0001.pdf	5/15/2022 6:13 AM	Adobe Acrobat D...	3,416 KB
 Duff - ABM Aviation Inc's Production Documents - ABM000039 - 000117.pdf	5/15/2022 6:10 AM	Adobe Acrobat D...	23,866 KB
Name	Date modified	Type	Size
 Duff_ABM & Frontier's Cross Claim against DAL Global.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	1,309 KB
 Duff_ABM Discovery Request to Plaintiff.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	10,017 KB
 Duff_ABM Initial Disclosures.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	16,239 KB
 Duff_ABM Notice of Removal.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	6,730 KB
 Duff_ABM Original Answer.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	1,240 KB
 Duff_ABM Production Docs 1.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	13,648 KB
 Duff_ABM Production Docs.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	7,775 KB
 Duff_ABM Response to P's Mtn for Leave to File Second Amend. Co...	5/18/2022 7:23 PM	Adobe Acrobat D...	3,357 KB
 Duff_ABM's Responses to P's Discovery Requests.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	6,526 KB
 Duff_ABM's Supplemental Responses to P's Discovery.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	5,723 KB
 Duff_P's Discovery Request to ABM.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	2,615 KB

Name	Date modified	Type	Size
 Duff_DAL Global Answer to Amended Co...	5/18/2022 7:23 PM	Adobe Acrobat D...	2,281 KB
 Duff_DAL Global Initial Disclosures.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	12,851 KB
 Duff_DAL Global Motion to Dismiss.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	2,730 KB
 Duff_DAL Global Reply to D.E. 37.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	1,076 KB
 Duff_DAL Global Response to DE 44.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	4,385 KB
 Duff_DAL Global Responses to P's Discov...	5/18/2022 7:23 PM	Adobe Acrobat D...	4,135 KB
Name	Date modified	Type	Size
 102726_CANNON 102726.txt	5/18/2022 7:23 PM	Text Document	137 KB
Name	Date modified	Type	Size
 Duff_Frontier Airlines Supp. Answers to ROGS.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	553 KB
 Duff_Frontier Original Answer.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	1,305 KB
 Duff_Frontier Production Docs.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	2,415 KB
 Duff_Frontiers Responses to P's Production Request.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	4,868 KB
 Duff_P's Request for Production from Frontier.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	2,146 KB
Name	Date modified	Type	Size
 Duff - Plaintiff's Production Docs to Defendant, Frontier Airlines, Inc - 4-8-21.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	174,262 KB
 Duff_Plaintiff's Original Petition.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	1,152 KB
 Duff_Plaintiff's Responses to RFDs.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	1,678 KB
 Duff_P's Responses and Objections to DAL Discovery.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	8,599 KB
 Duff_P's Responses to ABM Discovery.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	2,895 KB
 Duff_P's Responses to Frontier's Discovery Requests.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	5,554 KB
 Duff_P's Statement.pdf	5/18/2022 7:23 PM	Adobe Acrobat D...	547 KB

It is my understanding from a review of these documents that Ms. Duff was a passenger on Frontier Airlines flight number 2138 from Harry Reid International Airport (LAS) to George Bush Intercontinental Airport (IAH) on March 5, 2020. When the plane arrived at IAH gate A11, DAL Global employee Samantha Craig extended the jetbridge to the airplane. However, the jetbridge was not flush with the doorway of the plane. As described in an email by ABM employee Misti Cannon, the jetbridge was lower than the airplane doorway by “a good 6 inch height difference.” Three photographs showing the height difference are copied below.





Two ABM employees, Inesha Latulas and Aylancia Lillie, boarded the airplane from the jetbridge to provide wheelchair assistance to Ms. Duff. The employees had Ms. Duff transfer into an aisle wheelchair within the airplane and then strapped her into the chair. They had Ms. Duff cross her arms and hold them to her chest. The employees then strapped her arms and chest using two straps that crossed her upper body, they strapped down her legs by placing a strap over Ms. Duff's thighs, and they strapped down Ms. Duff's feet. As the employees proceeded to take the occupied aisle wheelchair through the door of the airplane and lower it onto the jetbridge, they either lost control of the wheelchair, causing Ms. Duff to hit her head on the doorframe of the airplane, or they unbuckled Ms. Duff, allowing her to fall to the jetbridge. Regardless of the actual scenario, Ms. Duff hit her head and may have lost consciousness. Ms. Duff complained of a headache, as well as neck and upper back pain, immediately after the incident. She was diagnosed with a closed head injury or concussion, post-concussion syndrome, and other injuries as detailed in her medical records.

First-hand descriptions of the incident differ to some degree. The differing statements and scenarios are described as follows:

Per Ms. Duff – “There was a bump that the ladies had to lift me over. However, when the (sic) lifted me they dropped me. The chair and I fell to the left, and I hit my head hard on the exit door frame of the airplane. At that point I became unconscious. When I regained my consciousness, I had both ladies and the chair on top of me [...] The ladies then climbed off of me, and began to take the straps off of me so the wheelchair could be moved off of me.”

Per Aylancia Lillie: “Once we got to the plane & the jet bridge we counted to 3 then I had lifted the bottom of the chair up. Once it hit the jet bridge she got scared started leaning to the side then she started choking almost from the seatbelt so I released the seat belt then she hit the jet bridge [...]”

Per Inesha Latulas: “We started pushing her, once we lifted her up. She leaned over as we picked her up and she tilted and fell out of the chair. Next thing I know she was on the grown (sic).”

ABM operations manager, Misti Cannon, was made aware of the incident and quickly responded. As she arrived at the gate, paramedics were heading up the jetway with Ms. Duff. Ms. Cannon proceeded down the jetway and met with ABM employees, Max Padilla and Fannie Dorsey, and Frontier Airways ramp manager Marcus Carter. The misalignment of the jetbridge with the doorway of the plane was identified and photographed. Employees Latulas and Lillie were interviewed. A summary of the interview is memorialized in the email from Ms. Cannon. The email states, in part:

They “explained to us that they took care to make sure that all of the seat belts were in place and proceeded to take her off the plane. When they had her halfway out, the aisle (sic) chair was tilted forward at an angle because of the height difference in the plane and the jetway. The aisle chair was never in jeopardy of tipping over but the [passenger] became panicked and started leaning over to the side. At that point, the seat belt restraints went to around her neck and she began to panic more. Aylancia then reached up and took the seat belt off and at that point the [passenger] fell out of the aisle chair to the floor halfway in and halfway out of the plane.”

After the incident, Max Padilla and Ms. Cannon met with Inesha Latulas and Aylancia Lillie. As written in Ms. Cannon's email, "we did explain to them that they needed to make sure that they escalated any issues that they see to their supervisor. We also informed them that as soon as they saw a problem they should have just pulled [Ms. Duff] back on the plane." Ms. Cannon ultimately suspended the two employees for 3 days, documenting on the ABM Notice of Corrective Action that the employees "failed to comply with the standard operating procedure for wheelchair on 3/5/2020." The employees had been trained to follow standard operating procedures and failed to do so. They "did not involve sup[ervisor] when having difficulties assisting aisle chair [passenger]." The two employees had to undergo retraining before being allowed to return to work.

When deposed, Ms. Cannon testified that the two ABM employees (Latulas and Lillie) would have taken the aisle wheelchair into the airplane from the jetbridge and, thus, would have encountered the threshold where the jetbridge met the plane. Ms. Cannon also testified that, as a supervisor, she would expect the two ABM employees to ensure a safe route exiting the plane with a passenger, which would include the transition and any associated height differential from the plane to the jetbridge. Ms. Cannon also testified that it was the two employees' responsibility: to ensure that Ms. Duff was secured in the aisle chair prior to exiting the plane, to mobilize the occupied aisle wheelchair off the plane, and to ensure that it was safe to exit the plane with the occupied aisle chair. Lastly, Ms. Cannon testified that, based on the content of her email and information as told by the two ABM employees, as opposed to personal knowledge, Ms. Duff was in the aisle chair properly and the employees did not drop her.

Review of Scientific and Technical Literature

I have reviewed the scientific literature related to injuries associated with wheelchair use. Unmat and Kirby reported on nonfatal wheelchair-related accidents reported to NEISS, the U.S. National Electronic Injury Surveillance System (1994). The authors evaluated 2,066 wheelchair related accidents reported through emergency departments to NEISS and found more than 70% of incidents were related to wheelchair tips and falls. Secondary factors contributing to tips and falls, such as stairs and ramps, were also noted. Xiang and colleagues conducted a similar study to evaluate injury trends over time (2006). Wheelchair tips and falls remained the leading mechanism of wheelchair-related injuries requiring medical care. The authors suggested that wheelchair-related accidents are multifactorial, involving engineering factors associated with the wheelchair, characteristics of the wheelchair user, factors related to the physical environment, and social influences. Opalek and colleagues reported on wheelchair falls treated in a Level I trauma center (2009). The authors found head or brain injury to be among the most common diagnoses after a fall from a wheelchair. Presperin Pederson and colleagues reported on air travel for people who use wheelchairs (2019). Based on a survey of 695 individuals who used wheelchairs for air travel, 55% of those who used an aisle or boarding chair found the aisle chair to be unstable, 11% tipped sideways, and 8% fell off the chair. Other literature referencing wheelchair safety speaks to the use of safety belts to prevent falls from wheelchairs.

Another area of the scientific literature relates to user and caregiver training in the use of assistive devices and wheelchairs. Assistive technology textbooks, such as *Assistive Technologies: Principles and Practices*, professional association white papers, such as the

RESNA Wheelchair Service Provision Guide, governmental agency standards, such as the U.S. Department of Health and Human Services *DMEPOS Quality Standards*, speak to the importance of training in the proper use of wheelchairs. To improve wheelchair safety, Dr. Lee Kirby and his colleagues at Dalhousie University have developed a wheelchair skills training program to teach wheelchair users how to safely perform various skills needed to effectively use their wheelchair. Based on the success of their training program, they adapted it to train caregivers how to operate a wheelchair. The caregiver training program specifically teaches a caregiver how to maneuver a manual wheelchair over obstacles, such as thresholds, and down a high curb. A video depicting pre- and post-training results for descending a high curb is provided here: <https://www.youtube.com/watch?v=8rLoCvBhgvo>. The complete training manual is found here:

<https://www.dropbox.com/scl/fi/e59ut9iggthgxe9ftvhjk/Caregiver-Manual.3-Wheelchair-Skills-Program.doc?dl=0&rlkey=y18hxcdks7e4yetnvchfbjxot>.

Additional links to materials showing how caregivers should maneuver an occupied wheelchair down a curb or stairs are provided below.

- <https://www.youtube.com/watch?v=xHxwvT1lAdc>
- <https://www.youtube.com/watch?v=CpttjIQpaal>
- <https://www.youtube.com/watch?v=dd242o2ozK0>
- https://www.youtube.com/watch?v=5De_6_Gfjq4&t=0s
- <https://www.youtube.com/watch?v=ypWlIPc4d0>
- https://www.healthwise.net/osumychart/Content/StdDocument.aspx?DOCHWID=custom.22_142

Training materials related to aisle wheelchairs are not readily available in the public domain. However, this video, <https://www.youtube.com/watch?v=tQXTkF5bE6Y>, shows a person with a disability transferring into an aisle wheelchair, getting strapped in, and being assisted into the airplane. In this video, the jetbridge is lower than the doorway of the plane, but the wheelchair operator simply tips the chair back on the rear wheels to clear the change in height.

Opinions

Based on my education and professional experience, my review of case documents provided to me, and my review of scientific and technical literature, I am able to provide the following initial opinions in this case.

1. Employees who provide wheelchair assistance for passengers boarding and deplaning commercial airplanes need to know how to safely maneuver occupied aisle wheelchairs across obstacles, such as doorway thresholds, slopes, and changes in height where the jetbridge meets the plane. Safe wheelchair handling techniques and proper direction of wheelchair travel across an obstacle, as demonstrated in the literature and videos cited in this report, need to be followed to ensure the safety of aisle wheelchair passengers. An occupied wheelchair should only be lifted as a last resort when crossing obstacles.
2. It is imperative that employees maintain control of an occupied aisle wheelchair at all times when operating the wheelchair, especially when traversing the obstacles cited above. The chair cannot be allowed to lean to one side, tip unexpectedly, or to be dropped.

3. On March 5, 2020, after ABM employees, Aylancia Lillie and Inesha Latulas, strapped Ms. Duff into the aisle chair, Ms. Duff was totally dependent upon them for her safety in exiting the airplane. Ms. Duff was completely restrained in the wheelchair by a foot strap, a thigh strap, and two additional straps that restrained her arms and upper body.
4. Differing descriptions of the events that occurred on March 5, 2020, resulting in Ms. Duff's injuries, have been provided. Ms. Duff states the ABM employees attempted to lift the aisle chair with Ms. Duff seated in it and lost control of the aisle chair, causing Ms. Duff to hit her head on the airplane doorframe. The written ABM employee statements reference lifting the occupied chair, Ms. Duff leaning over to one side, and ultimately falling out of the wheelchair. Aylancia Lillie's statement goes into more detail, describing how Ms. Duff was leaning and almost choking on the seat belt, so she released the seat belt, which resulted in Ms. Duff falling to the jetbridge. Regardless of which scenario occurred, both reflect unsafe wheelchair handling practices. First, the employees attempted to lift an occupied aisle chair when doing so was not necessary. Second, the employees had the wheelchair oriented in the wrong direction to descend a substantial drop in height. Third, they either lost control of the wheelchair or they unbuckled Ms. Duff, allowing her to fall from the chair.
5. Aylancia Lillie and Inesha Latulas failed to exercise the care needed to safely transport Ms. Duff off the airplane on March 5, 2020. They also failed to follow ABM standard operating procedures, resulting in their suspension and implementation of corrective action. Stated another way, the employees did not meet the standard of care related to wheelchair mobility performed by an attendant or caregiver.
 - a) The employees should have identified the hazard posed by the misalignment of the jetbridge to the airplane doorway and asked Frontier Airlines or DAL Global personnel to raise the jetbridge to minimize the hazard before attempting to exit the plane. Or, they should have contacted their supervisor for guidance.
 - b) In the absence of (a) directly above, the employees should have stopped immediately as they began to encounter problems getting Ms. Duff off the plane, moved Ms. Duff back into the airplane, and regrouped. At that point, they could have then pursued any of a number of options, such as those presented in (a) above, having Ms. Duff walk off the plane, or turning the aisle chair around so Ms. Duff would exit the plane backwards in the aisle chair.
 - c) In the absence of (a) above, the employees should have turned the occupied aisle wheelchair around to exit the airplane in reverse before first attempting to transport Ms. Duff off the plane. This would allow the rear wheels to be safely brought down to the jetbridge in a controlled manner and the aisle wheelchair to be oriented in a rearward tilt as it transitions from the airplane to the jetbridge, which is safer and more stable for the wheelchair occupant. This is also the technique taught for safe wheelchair handling by caregivers.

Closing Comments

In summary, the two ABM Aviation employees who were attempting to transport Ms. Duff off the airplane at George Bush Intercontinental Airport (IAH) on March 5, 2020 failed to exercise the standard of care associated with the safe operation and handling of an occupied wheelchair. The employees, Aylancia Lillie and Inesha Latulas, attempted to lift Ms. Duff, who was seated and fully strapped into an aisle wheelchair, to traverse a hazardous drop in height from the airplane to the jetbridge. They either lost control of the wheelchair, causing Ms. Duff

to hit her head on the door frame of the airplane, or they unbuckled her from the aisle wheelchair, causing her to fall to the jetbridge. Ms. Duff suffered a head injury, the effects of post-concussion syndrome, and other injuries, as detailed in her medical records. I hold my opinions to a reasonable degree of scientific certainty. And, I reserve the right to amend my opinions, should additional information become known.

Respectfully submitted,

A handwritten signature in cursive script that reads "Jonathon Z. Schuch". The signature is written in black ink and is positioned above the printed name.

Jonathon Z. Schuch, P.E.
JZS Consulting, LLC